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Exclusivity Clauses: Enhancing Competition, Raising Prices*

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Abstract

In a setting where retailers and suppliers compete for each other by offering binding contracts, exclusivity clauses serve as a competitive device. As a result of these clauses, firms addressed by contracts only accept the most favorable deal. Thus the contract-issuing parties have to squeeze their final customers and transfer the surplus within the vertical supply chain. We elaborate to what extent the resulting allocation depends on the sequence of play and discuss the implications of a ban on exclusivity clauses.

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1 Introduction

If a firm accepts a contract with an exclusivity clause, it may not deal with competitors of the firm that issued the contract. The debate on such exclusivity agreements divides policy makers and scholars into two fractions. Critics argue that exclusivity clauses are anticompetitive because they foreclose entry.[1] Advocates invoke efficiency motives, claiming that exclusivity protects value-generating investments from free-riding.[2]

In this paper, we compare arguments for and against exclusivity clauses. To do so, it is crucial to specify which type of exclusivity we are looking at. According to Segal and Whinston (2000a), "a contract between a buyer and a seller is said to be exclusive if it prohibits one party to the contract from dealing with other agents." In our model, the character of exclusivity depends on which side of the market offers contracts. Most of the existing literature deals with what is usually called "exclusive dealing": Suppliers write contracts with exclusivity clauses, which prohibit retailers to purchase from other suppliers. In addition to this, we also discuss what we refer to as "exclusive provision": Retailers offer contracts with exclusivity clauses, which stipulate that contracting suppliers are not allowed to additionally sell to other retailers.

A prominent example for exclusive provision is the distribution of Apple's *iPhone* via selected service providers.[3] For instance, in the United States, the *iPhone* was sold exclusively through AT&T between 2007 and

[1]Proponents of the foreclosure argument include Aghion and Bolton (1987), Rasmusen, Ramseyer, and Wiley (1991), and Segal and Whinston (2000b). Upon Fumagalli and Motta's (2006) critique that the former authors' findings rely on buyers being final customers, Simpson and Wickelgren (2007) and Wright (2009) extend the argument to a setting more similar to ours, including buyers competing in a downstream market.

[2]Proponents of the incentives argument include Williamson (1979) and Marvel (1982). Segal and Whinston (2000a) and Bernheim and Whinston (1998) specify that the efficiency-enhancing property of exclusivity clauses only holds in cases where investment has external effects on third parties.

[3]The arrangements between Apple and the service providers are usually referred to as "tying" agreements. In the present paper, however, we ignore the complementary between the primary good and potential services provided by retailers. In fact, we consider retailers as pure reselling entities.

2011.[4] That is, every customer who wanted to buy an *iPhone* had to accept AT&T's monopoly price. Obviously, this generates a correspondingly high willingness-to-pay for exclusivity on behalf of AT&T. As financial data suggests, it was indeed Apple who ended up reaping the bulk of the benefits from this exclusivity arrangement.[5]

In the following, we show that this straightforward mechanism carries over to more competitive settings. This is remarkable, as even with several retailers reselling a homogeneous product obtained from multiple suppliers, the resulting allocation might be the same as in the monopoly case.[6]

Imagine a setting with two suppliers and two retailers. Exclusivity clauses require that the suppliers sell their product to only one retailer.[7] In return, a retailer could offer more favorable quantities and wholesale prices. Alternatively, the retailer could offer less favorable terms, but allow the suppliers to contract with its competitor as well. If both retailers choose this second option, they effectively eliminate competition between them *in the upstream market*: as long as the suppliers' production cost is covered, both offers are accepted. In this case, the retailers purchase Cournot quantities and both make positive profits. However, if a retailer found a way to also eliminate competition *in the downstream market*, its margin would be even higher. By means of the exclusivity clause, it is equipped with an instrument which facilitates this purpose. An arbitrarily small compensation is sufficient to induce both suppliers to accept such a clause. Hence, both of them provide the same retailer, which in turn obtains a monopoly position in the downstream market.

Of course, one retailer obtaining the monopoly profit and the other getting nothing cannot be an equilibrium. Facing exclusivity clauses, suppliers

[4]Similar agreements were established in numerous other countries, such as Germany (T-Mobile), UK (O2), Japan (SoftBank Mobile), and Spain (Movistar).

[5]See, for instance, Kuittinen (2012). Another example for exclusive-provision contracts is the wide-spread use of exclusive broadcasting rights for major sport events. For an overview of competition issues in this context, see OECD (2013).

[6]For the sake of brevity, we do not show the equivalence between the monopolistic and the competitive setting here. The results are available on request.

[7]Accordingly, we consider exclusive provision as defined above. We formally discuss this case in Section 3. The conclusions drawn here are only partially applicable to exclusive dealing, as we show in Section 4.

have to select a single retailer. Hence they only head for the most favorable deal. This in turn induces tough competition between the retailers. In fact, they are forced to extract as much consumer surplus as possible and redirect it to the suppliers. Thus exclusivity clauses strengthen competition, but competition for the suppliers instead of competition for the customers.

Our efficiency argument is quite in contrast with a variety of papers that support the traditional Chicago School argument that exclusivity clauses mainly arise to economize on transaction costs.[8] In Marvel (1982), exclusive dealing allows suppliers to prevent retailers from opportunistic behavior. Once the retailers refrain from buying no-frills substitutes, suppliers are willing to invest into value-generating pre-sale information. Thus exclusive dealing provides a supplier with a property right on promotional expenses. In a similar vein, McAfee and Schwartz (1994) show that a (monopolistic) supplier is confronted with its own incentive to renegotiate terms with competing retailers. Doing so impairs the rewards for incumbent retailers and decreases their ex-ante willingness to pay. Exclusivity clauses are an easily observable and verifiable approach to curb such opportunism. As in Marvel (1982), they increase the joint profit by inducing a higher level of investment. Accordingly, demand might increase as well. This, in turn, leaves the potential for positive welfare implications.

In contrast, welfare is clearly negatively affected if exclusivity clauses are strategically deployed to deter entry which otherwise would have taken place. In Rasmusen, Ramseyer, and Wiley (1991) and Segal and Whinston (2000b), suppliers need to reach a certain scale to produce at minimum average cost. By locking in sufficiently many buyers, an incumbent supplier can thus prevent entry of competitors, and buyers agree to sign contracts including exclusivity clauses. In an earlier article, Aghion and Bolton (1987) show that entry prevention is also possible without a positive minimum efficient scale if the incumbent can draw on more sophisticated contracts including "liquidated damages" clauses. Such contingent transfers to the incumbent

[8] Classical examples are Bork (1978) and Williamson (1979).

supplier serve as an entry fee for outside suppliers, and enable the incumbent supplier–retailer pair to extract monopoly rents.[9]

Our model builds upon a similar idea, although we drop the asymmetry between incumbents and entrants and thus investigate a more competitive framework. Consequently, contracting parties use exclusivity clauses not for strategic purposes but because they are forced to use them to withstand competition. This turns out to be self-destructive. Whenever a contract-issuing firm employs an exclusivity clause, it has to promise the most favorable prices and quantities to its counterparties. Thus it ends up with zero profit. Altogether, we obtain the same quantities and prices as in a setting with a single vertically integrated firm.[10]

We organize the paper as follows. In Section 2 we introduce the model. Next we discuss how the outcome depends on the sequence of play. In Section 3 we study the case of exclusive provision. We distinguish between two scenarios: fist we study homogeneous suppliers; then we consider a situation in which their costs of production differ. In the latter instance, screening becomes possible, along with an outcome where only the efficient supplier prevails. In Section 4 we contrast exclusive provision with exclusive dealing, the standard setting in the literature. Exclusivity clauses now force *suppliers* to maximize the retailers' individual profits. This induces Cournot rather than monopoly quantities, resulting in a lower customer price. While a ban on exclusive provision may increase welfare, prohibiting exclusive dealing has adverse effects: Absent exclusivity clauses, suppliers set their wholesale prices above marginal cost. In turn they have to reduce their quantities, as otherwise the retailers buy from one supplier only. This increases the customer price in the downstream market. In Section 5, we take account of the conflicting implications of exclusive provision and exclusive dealing.

[9]In line with the existing theory, the empirical literature on exclusivity clauses is inconclusive. Evidence on customer price effects is scarce and mainly centered around the beer brewing industry. For an overview, see Lafontaine and Slade (2008). Furthermore, authors such as Slade (2000) and Asker (2004) find that exclusivity constraints lead to higher markups of the vertical supply chain and increased customer prices. These observations are consistent with both lines of reasoning.

[10]To be precise, this conclusion is restricted to the exclusive-provision framework. With exclusive dealing, the maximization of individual retailers' surpluses entails Cournot quantities and prices.

Which type of contract arises endogenously? We conjecture that retailers could confront exclusive-dealing contracts with more profitable counteroffers. Exclusive-provision contracts are less vulnerable, thus we expect the retailers to make offers in equilibrium. In Section 6, we conclude by discussing our results in light of their policy implications. All proofs are relegated to the appendix.

2 Model

We consider the following vertical relation. Suppliers produce a good, which they sell to retailers. These, in turn, resell it to final customers. Demand is given by $p(Q) = a - bQ$, where p is the output price and Q is the total quantity sold in the downstream market. Demand is positive for a positive range of p, and the law of demand applies; that is, $a > 0$ and $b > 0$.

In the upstream market there are two groups of strategic players: two suppliers and two retailers.[11] Each supplier $s \in \{H, L\}$ maximizes the expected value of

$$\pi_s = \sum_{r \in \{1,2\}} (w_{sr} - c_s) q_{sr}, \tag{1}$$

where q_{sr} is the quantity of the output that supplier s sells to retailer $r \in \{1, 2\}$, and w_{sr} is the (per-unit) wholesale price. c_s is the marginal cost of production of supplier s.[12] We assume supplier H to be (weakly) less efficient than supplier L. Specifically, $c_H = c + \Delta$, and $c_L = c - \Delta$ with $\Delta \geq 0$. Suppliers cannot sell their output directly to customers. Instead, supplier s sells it at a wholesale price w_{sr} to retailer r.

The retailers buy the input in the upstream market and sell it to final customers. Each retailer $r \in \{1, 2\}$ maximizes the expected value of

$$\pi_r = \sum_{s \in \{H,L\}} (p(Q) - w_{sr}) q_{sr}, \tag{2}$$

[11] Most of the results which follow are readily applicable to settings with more firms, because Bertrand-related mechanisms lead to perfect competition already with two firms.

[12] From $p(Q) = a - bQ$, we see that $c_s \geq a$ implies that there are no gains from trade. Therefore, without any loss of generality, we impose that $c_s < a$ for $s \in \{1, 2\}$.

with $Q = \sum_{s\in\{H,L\}} \sum_{r\in\{1,2\}} q_{sr}$. r resells the product to final customers. For simplicity, we assume that this can be done without incurring any additional (reselling) cost.

The determination of w_{sr} and q_{sr} crucially depends on the sequence of moves. In Section 3, we consider the case where the retailers fix wholesale prices and quantities which they are willing to buy. In Section 4, the suppliers announce terms of sale. We specify the contracts below, along with the exclusivity clauses which the firms may impose. For now, a general description of the contracting game suffices: In a first stage, either the retailers (Section 3) or the suppliers (Section 4) make binding take-it-or-leave-it offers. In the second stage, the recipients of the contracts may accept one, both, or none of these offers. Their choice might be restricted, as they potentially have to abide by exclusivity clauses.[13]

We focus on symmetric, subgame-perfect Nash equilibria in pure strategies, according to the following assumptions.

Assumption 1 (Symmetry). Identical players choose identical strategies. As the suppliers differ in their production efficiency, Assumption 1 only applies to the retailers.

Assumption 2 (Pure Strategies). We analyze Nash equilibria in pure strategies. If a retailer faces two identical offers from suppliers H and L, the offer from (the more efficient) supplier L is chosen. If a supplier faces two identical offers from (identical) retailers, each of these offers is selected with probability 0.5.

Assumption 3 (Subgame Perfection). The contract-submitting parties do not make offers which generate negative payoffs if accepted. Accordingly, we rule out equilibria in weakly dominated strategies.

[13]From the nature of exclusivity clauses, it follows that such clauses are imposed by the firms which offer quantities and wholesale prices. To see this, suppose to the contrary that a firm makes an offer which restricts it (instead of its trading partners) not to deal with other parties. Such a contract fails to specify what happens once more than one trading party accepts.

3 Exclusive Provision

In this section, we consider the case where the retailers $r \in \{1, 2\}$ make binding offers, and the suppliers $s \in \{H, L\}$ select among these. Offers from the retailers are of the type $\Phi_r := (q_r, w_r, e_r)$, where $q_r = q_{sr}$ for $s = \{H, L\}$, and $w_r = w_{sr}$ for $s = \{H, L\}$. Furthermore, e_r is a binary choice variable, which indicates whether retailer r stipulates an exclusivity clause. If $e_r = 1$, each supplier which sells to r is not allowed to sell the product to the other retailer. If $e_r = 0$ for $r = \{1, 2\}$, the suppliers are allowed to accept both offers.[14]

In Figure 1, we illustrate exclusive provision. In the upper-left diagram, we depict a situation without exclusivity clauses. Thus both suppliers, s_1 and s_2, can provide both retailers, r_1 and r_2. In the upper-right diagram, a supplier selling its product to r_2 is not allowed to additionally provide r_1. Meanwhile, there is no contractual restriction which prevents r_1's suppliers to also provide r_2. Nevertheless, s_1 cannot serve both retailers either. If s_1 approaches r_2, it forgoes the possibility to provide r_1. We depict this in the lower-left panel. In fact, the suppliers' options are equally restricted, regardless of whether one or both retailers impose exclusivity clauses. Accordingly, in both instances we obtain the same set of possible outcomes (compare the upper-right panel with the lower-right panel).

In order to derive equilibria Φ_r^* (and eliminate putative equilibria $\hat{\Phi}_r$), we study properties of q_r, w_r, and e_r which necessarily hold whenever no retailer has a unilateral incentive to offer an alternative bundle $\tilde{\Phi}_r$.[15] At the end of this section, we show that equilibria Φ_r^* necessarily feature exclusivity clauses. For the moment, to facilitate the analysis, we simply assume that $e_r^* = 1$ for $r = \{1, 2\}$.

[14] Note that, say, $e_1 = 1$ and $e_2 = 0$ implies that the suppliers cannot deal with both retailers. Thus a retailer can single-handedly install overall exclusivity, and no retailer can unilaterally remove an overall exclusivity regime if $e_r = 1$ for $r = \{1, 2\}$.

[15] In this section, we interchangeably use Φ_r^* to denote equilibria and equilibrium contracts (analogous with putative equilibria $\hat{\Phi}_r$). Implicitly, equilibria further require that each supplier accepts the most profitable contract. (Regarding ties, see Assumption 2.)

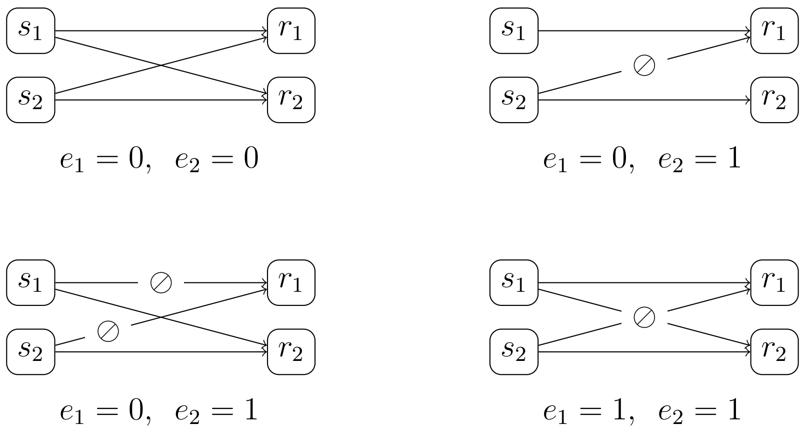

Figure 1: Exclusive Provision

From (2), we can write the expected profit of retailer r as[16]

$$E[\pi_r] = \sum_{x \in \{1,2\}} P[r \text{ has } x \text{ suppliers}](p(Q) - w_r)xq_r. \tag{3}$$

From (1), it further follows that supplier s's profit upon accepting r's offer is

$$\pi_s(r) = (w_r - c_s)q_r. \tag{4}$$

Provided that both suppliers' participation constraints are satisfied ($\pi_s(r)$ is non-negative for either r), we infer from (4) that supplier $s \in \{H, L\}$ approaches retailer r whenever $q_r(w_r - c_s) > q_{-r}(w_{-r} - c_s)$. If $q_r(w_r - c_s) = q_{-r}(w_{-r} - c_s)$, each supplier is indifferent between the two retailers, and Assumption 2 implies that the suppliers accept the offer of each retailer with probability 1/2. In this case, r obtains $2q_r$ with probability 1/4, q_r with probability 1/2, and 0 with probability 1/4. Accordingly, (3) equals

$$\pi_r = \begin{cases} (a - 2bq_r - w_r)2q_r & \text{if } (w_r - c_s)q_r > (w_{-r} - c_s)q_{-r}, \\ \left(a - \frac{b}{2}(3q_r + q_{-r}) - w_r\right) q_r & \text{if } (w_r - c_s)q_r = (w_{-r} - c_s)q_{-r}, \\ 0 & \text{if } (w_r - c_s)q_r < (w_{-r} - c_s)q_{-r}. \end{cases} \tag{5}$$

[16]For ease of notation, we omit the expectation operator in the following.

By means of the following lemmas, we show that for $c_H = c_L$ the retailers strongly compete for the two suppliers. For sufficiently high levels of Δ, they only compete for the efficient supplier L, and the less efficient supplier H is driven out of the market.

Note that Lemmas 1 trough 4 throughout make reference to equilibria where the retailers make offers. Furthermore, we consistently suppress the implicit assumption that $e_r^* = 1$ for $r \in \{1, 2\}$.

Lemma 1. *Both retailers obtain zero profit. Thus, if both suppliers' participation constraints are satisfied, we have*

$$w_r^* = a - b2q_r^*. \tag{6}$$

If only the efficient supplier's participation constraint is satisfied, we have

$$w_r^* = a - bq_r^*. \tag{7}$$

Lemma 1 implies zero profits on behalf of the retailers, which is a necessary condition for each individual retailer to not having an incentive to outbid its opponent's offer (and thereby double its own customer base).

Lemma 2. *If both suppliers' participation constraints are satisfied, the profit of either supplier H or supplier L is maximized subject to* (6)*. If only the efficient supplier L's participation constraint is satisfied, L's profit is maximized subject to equation* (7)*.*

For some intuition for Lemma 2, consider Figure 2, where $w_r = a - 2bq_r$ depicts the zero-profit line of the retailers for the case where both suppliers accept an offer. From equation (4), we can state supplier s's marginal rate of substitution between q_r and w_r at $(\hat{q}_r, \hat{w}_r)$ as[17]

$$\mathrm{MRS}_s(\hat{q}_r, \hat{w}_r) := -\frac{\hat{w}_r - c_s}{\hat{q}_r} > -2b,$$

[17] As can be seen in Figure 2 (and will be of importance later on), the absolute value of $\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r)$ exceeds the absolute value of $\mathrm{MRS}_H(\hat{q}_r, \hat{w}_r)$. This is because the lower marginal cost of supplier L leads to higher markups for L than for H ($\hat{w}_r - c_L > \hat{w}_r - c_H$). Accordingly, to sustain the profit at a constant level, a reduction in q_r requires a higher compensation for L than for H.

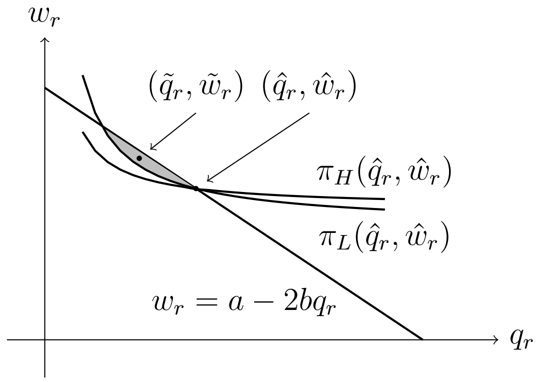

Figure 2: If no suppliers' profit is maximized conditional on $w_r = a - 2bq_r$, a deviating retailer can attract both suppliers and obtain a positive profit.

In the example of Figure 2, in contrast to Lemma 2, neither supplier L's nor supplier H's profit is maximized conditional on the retailers' zero-profit condition. Specifically, we have $\mathrm{MRS}_s(\hat{q}_r, \hat{w}_r) > -2b$ for $s \in \{H, L\}$. Due to the intersection of the suppliers' isoprofit curves with the retailers' zero-profit line, a deviating retailer r could instead offer $(\tilde{q}_r, \tilde{w}_r)$ within the shaded region in Figure 2. Since for both suppliers such an offer would lead to higher profits than $(\hat{q}_r, \hat{w}_r)$, the deviating retailer r would attract both H and L. Hence, r's zero-profit line would be unaffected, which implies that $(\tilde{q}_r, \tilde{w}_r)$ would lead to positive profits. In this case, as well as in all other cases where not at least either H's or L's profit is maximized conditional on the retailers' zero-profit condition, $(\hat{q}_r, \hat{w}_r)$ cannot be part of an equilibrium.

It directly follows from Lemma 2 that in the case of homogenous suppliers, both retailers offer (half of) the monopoly quantity.

Corollary 1. *For $\Delta = 0$, we have $q_r^* = (a - c)/4b$ and $w_r^* = (a + c)/2$.*

Simple as it is, Corollary 1 conveys a central result of this paper: The retailers' exclusivity clauses imply that only the best offer has a chance of being accepted. Hence competition is vigorous. Not only do the retailers offer wholesale prices which equal the price they charge their final customers. In addition, total quantities aggregate to the amount a monopolistic vertically integrated firm would sell. Once all retailers offer their share of the monopoly quantity, the final price is independent of the suppliers' allocation. Thus if

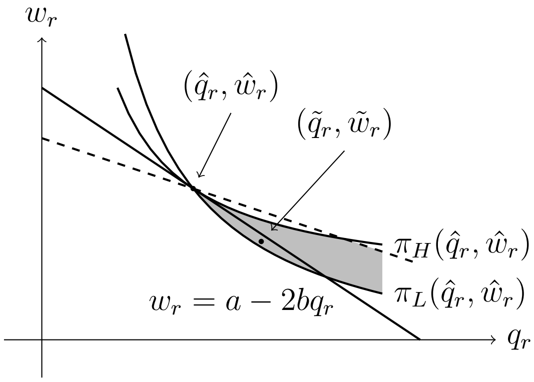

Figure 3: If supplier H's profit is maximized conditional on $w_r = a - 2bq_r$, a deviating retailer can attract supplier L and obtain a positive profit.

an individual retailer lowers its quantity, it would be disregarded by the suppliers. By offering more, it would make losses.

In a similar way as in Lemma 2, next we rule out equilibria where the profit of supplier H is maximized.

Lemma 3. *For $\Delta > 0$, an outcome where the profit of supplier H is maximized subject to* (6) *cannot be an equilibrium.*

In a putative equilibrium $\hat{\Phi}_r$ where the profit of the less efficient supplier H is maximized (conditional on $w_r = a - 2bq_r$), the (absolute value of the) marginal rate of substitution of supplier L exceeds the slope of the zero-profit line of the retailers (see Figure 3). Due to the intersection of L's isoprofit curve with the retailers' zero-profit line, a deviating retailer r could instead offer $\tilde{\Phi}_r$, which lies in the region of positive profits for the retailers, even with the original zero-profit line. Furthermore, by offering $\tilde{\Phi}_r$, supplier r's zero-profit line becomes $w_r = a - b\hat{q}_r - bq_r$. That is, it rotates around $(\hat{q}_r, \hat{w}_r)$, as indicated by the dashed line in Figure 3. If retailer r offered any contract within the shaded area in Figure 3, the inefficient supplier H would strictly prefer the opponent retailer $-r$ (which offers $\hat{\Phi}$), and the efficient supplier L would strictly prefer r. Hence, by exclusively attracting supplier L, r could increase its profit, which eliminates $\hat{\Phi}_r$.

From Lemmas 1 through 3, it follows that in any symmetric equilibrium, the profit of supplier L must be maximized subject to (6) or (7), that is, to a zero-profit condition of the retailers. As we show next, whenever this implies that both suppliers' participation constraints are satisfied, there are profitable deviations possible (unless if $\Delta = 0$, see Corollary 1), and there is no equilibrium. However, if c_L and c_H are sufficiently far apart from each other, there exists a unique equilibrium where only the efficient supplier L is attracted by the retailers.

Lemma 4. *For $\Delta > 0$, there exists no equilibrium where both suppliers' participation constraints are satisfied. If $\Delta > (a-c)/3$, there exists a unique equilibrium in which H's participation constraint is violated.*

To see this, first consider a candidate equilibrium where both suppliers participate. From Lemmas 2 and 3, we know that $\text{MRS}_L(\hat{q}_r, \hat{w}_r) = -2b$ in such an equilibrium. Since $\text{MRS}_L(\hat{q}_r, \hat{w}_r) < \text{MRS}_H(\hat{q}_r, \hat{w}_r)$, it is generally possible to increase q_r and decrease w_r in a way that the new contract $\tilde{\Phi}_r$ is only attractive for supplier L. As a consequence, the zero-profit line rotates around $(\hat{q}_r, \hat{w}_r)$ (see Figure 3) such that $\tilde{\Phi}_r$, which leads to negative profits according to the original zero-profit line, becomes profitable.[18]

Deviations of this type, however, are not feasible if an equilibrium contract Φ_r^* violates supplier H's participation constraint. In this case, it follows from Lemmas 1 and 2 that any profitable deviation involves attracting the inefficient supplier H. Since the region of profitable contracts with two suppliers, $w_r < a - b2q_r$, is a subset of the region of profitable contracts with one supplier, $w_r < a - bq_r$, there is no profitable deviation which involves attracting both suppliers. Hence, the only possible deviation would be attracting supplier H without attracting supplier L. However, since L would stay with the other retailer, any quantity provided by supplier H would further deteriorate the customer price p. As can be seen in Figure 4, it follows from the retailers' zero-profit condition ($w_r^* = p^*$) and H's non-participation condition ($w_r^* < c_H$) that $p^* < c_H$. Hence, no contract $\tilde{\Phi}_r$ with $\tilde{q}_r > 0$ and $\tilde{w}_r \geq c_H$ would lead to positive profits of the retailer, indicated by the shaded area in Figure 4. Therefore, whenever maximizing supplier L's profit conditional on the retailers' zero-profit condition (7) leads to a wholesale price below c_H,

[18]Instead of attracting each supplier with probability 1/2, the deviating retailer attracts supplier L for sure.

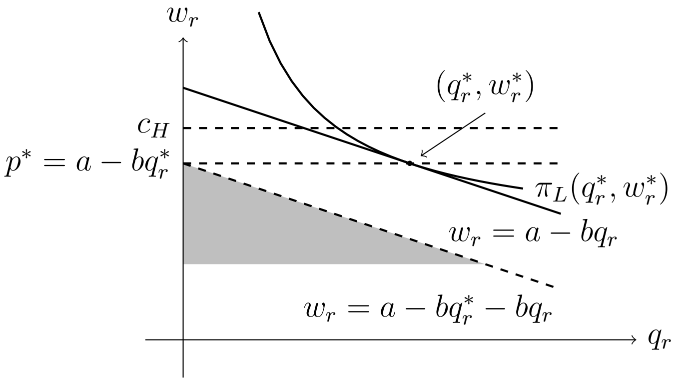

Figure 4: If supplier L's profit is maximized conditional on $w_r = a - bq_r$, and c_H is sufficiently high, no contract for which $w_H \geq c_H$ is profitable.

there exists an equilibrium where the less efficient supplier H does not accept any offer. This is the case if and only if

$$w_r^* = \frac{a + c_L}{2} < c_H \quad \Leftrightarrow \quad \Delta > \frac{a - c}{3}.$$

What Happens if Exclusivity Clauses are Banned? Suppose now that exclusivity clauses are illegal. In this case, supplier $s \in \{H, L\}$ accepts any offer with $w_r \geq c_s$. Accordingly, each retailer sets $w_r^{NE} = c_L$. Furthermore, from quantity competition in the downstream market, both retailers purchase the Cournot quantity $q_r^{NE} = (a - c_L)/3b$, and obatain $\pi_r^{NE} = (a - c_L)^2/9b$.

Will Exclusivity Clauses Be Used? When exclusivity clauses are allowed, will they actually be used?

From the previous paragraph, we know that in a candidate equilibrium without exclusivity clauses, both suppliers obtain zero profit, that is, $\pi_s^{NE} = 0$ for $s \in \{H, L\}$.

If $\Delta > 0$, by offering $\tilde{\Phi}_r$ with $\tilde{w}_r = c_L + \varepsilon$ with $\varepsilon > 0$ sufficiently small, even in combination with an exclusivity clause, r could attract L without attracting H. As a monopolist in the downstream market, r could set $\tilde{q}_r = (a - \tilde{w}_r)/2b$. Since $\tilde{\pi}_r = (a - \tilde{w}_r)^2/4b$ exceeds π_r^{NE} for $\varepsilon < (a - c + \Delta)/3$, this eliminates the candidate equilibrium without exclusivity clauses.

If $\Delta = 0$, r would attract both suppliers by offering $\tilde{w}_r = c+\varepsilon$, and could therefore set $\tilde{q}_r = (a-c)/4b$. For $\varepsilon < (a-c)/3$, this constitutes a profitable deviation.

Regarding equilibria with exclusivity clauses, a unilateral deviation from $e_r^* = 1$ to $\tilde{e}_r = 0$ is effectless. As the other retailer maintains $e_{-r}^* = 1$, the suppliers still have to choose between the two retailers. Hence, the above results, together with $e_r^* = 1$ constitute an equilibrium indeed.

Proposition 1 summarizes the results of this section.

Proposition 1. *Consider the case where retailers can engage in exclusive provision. For $\Delta = 0$, there is a unique equilibrium, where each retailer offers Φ_r^* with $q_r^* = (a-c)/4b$, $w_r^* = (a+c)/2$, and $e_r^* = 1$. Both suppliers choose each retailer with probability $1/2$. The corresponding output price is $p^* = (a+c)/2$. Both retailers make zero profit. The profit of each supplier $s \in \{H, L\}$ is $\pi_s^* = (a-c)^2/8b$. For $0 < \Delta < (a-c)/3$, there is no equilibrium. For $\Delta \geq (a-c)/3$, there is a unique equilibrium, where each retailer offers Φ_r^* with $q_r^* = (a-c+\Delta)/4b$, $w_r^* = (a+c-\Delta)/2$, and $e_r^* = 1$. Supplier L chooses each retailer with probability $1/2$. Supplier H does not accept any offer. The output price is $p^* = (a+c-\Delta)/2$. Both retailers and supplier H make zero profit. Supplier L obtains $\pi_L^* = (a-c+\Delta)^2/4b$.*

4 Exclusive Dealing

Now we look at the opposite setting where the suppliers $s \in \{H, L\}$ make binding offers, and the retailers select among these. Offers from the suppliers are of the type $\Phi_s := (q_s, w_s, e_s)$, where $q_s = q_{sr}$ for $r = \{1, 2\}$, and $w_s = w_{sr}$ for $r = \{1, 2\}$.[19] Analogous to the case above, e_s indicates whether s stipulates an exclusivity clause. If $e_s = 1$, each retailer which purchases q_s at w_s from s is not allowed to purchase the product from the other supplier. If $e_s = 0$ for $s = \{H, L\}$, the retailers are allowed to purchase from both suppliers.

[19] By analogy with our previous notation (see footnote 15), we use (Φ_H^*, Φ_L^*) to denote both equilibria and equilibrium contracts. The same applies to putative equilibria $(\hat{\Phi}_H, \hat{\Phi}_L)$.

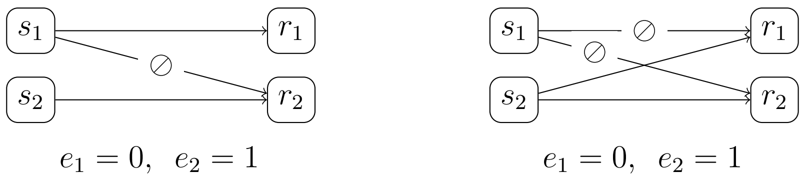

Figure 5: Exclusive Dealing

In Figure 5, we illustrate exclusive dealing. When either none or both suppliers impose exclusivity clauses, the firms' possibilities to cooperate are equally restricted as with exclusive provision. Thus we refrain from replicating the respective diagrams from Figure 1. If only one supplier requires exclusivity, the choice of the retailers is restricted. Each of them can only purchase from one supplier. In the left panel, we depict a situation where retailer r_2, which purchases from supplier s_2, is contractually restricted to not purchase from supplier s_1. Retailer r_1 is not restricted by its own supplier, s_1. However, r_1's choice is equally limited, since s_2 refuses to deal with r_1 as long as r_1 maintains its relation with s_1. Otherwise put, in order to purchase from s_2, r_1 has to forego its relation with s_1 (see the right panel).

In any equilibrium (Φ^*_s, Φ^*_{-s}) where both retailers accept the offer of supplier s, accepting this offer must be a weakly dominant strategy. To avoid repetitions, we occasionally refer to Result 1, which states that dominance can be broken down to a single condition.

Result 1. *Choosing supplier s is a (weakly) dominant strategy (over choosing supplier $-s$) if and only if*

$$(a - 2bq_s - w_s)q_s > (\geq) \;\; (a - bq_s - bq_{-s} - w_{-s})q_{-s}. \tag{8}$$

Accordingly, whenever s caters both retailers, each retailer would also accept s's offer if the other retailer would not. Therefore, in the subgames where the retailers choose their suppliers, every equilibrium where s prevails is an equilibrium in dominant strategies.

As in the previous section, we derive (Φ^*_H, Φ^*_L) by means of a number of lemmas. In Lemmas 5 through 8, we suppress that we refer to equilibria where the suppliers make offers. At the end of this section, we show that in most circumstances equilibria necessarily feature exclusivity clauses, and in the remaining cases where equilibria without exclusivity clauses exist, this is because there is a de-facto monopoly on behalf of the more efficient supplier L. For the moment, we simply assume that $e_s^* = 1$ for $s \in \{H, L\}$.

Lemma 5. *The less efficient supplier H is not chosen by any retailer.*

The intuition for Lemma 5 is simple: If supplier H's contract was to be accepted, it must be strictly better than L's offer. Thus L could undercut H by mimicking H and marginally lower the offered wholesale price. This is possible unless $\hat{w}_H = c_H$ and $c_H = c_L$. Nevertheless, also this remaining case cannot be an equilibrium. Since H's offer would be strictly better that L's offer, H could marginally decrease its offered wholesale price. Its offer would still be strictly better, and H could obtain a positive profit. This eliminates all putative equilibria of this type.

Lemma 6. *Supplier H sets $w_H^* \geq c_H$, supplier L sets $w_L^* \leq c_H$.*

The first statement of Lemma 6 directly follows from Assumption 3: Each putative equilibrium where supplier H sets its wholesale price below marginal cost violates subgame perfection. The second statement stems from the fact that H could obtain a positive profit by slightly undercutting L's offer whenever $\hat{w}_L > c_H$. This is in contradiction with Lemma 5.

Lemma 7. *If $\Delta \geq 3(a-c)/5$, there exists a continuum of equilibria with $q_L^* = (a-c_L)/4b$ and $w_L^* = (a+c_L)/2$. If $0 \leq \Delta < 3(a-c)/5$, every equilibrium features $w_L^* = w_H^* = c_H$.*

From Result 1 we know that a necessary condition for supplier H to profitably enter is to attract one retailer, given the other retailer sticks with L. Although the retailers make zero profit at L, to offer a mutually profitable contract $\tilde{\Phi}_H$, the inefficient supplier H must ensure that the resulting total quantity $\tilde{q}_H + q_L^*$ is low enough to cause the customer price taking on a value above $\tilde{w}_H$. Since the low marginal cost c_L of supplier L further implies a high (monopoly) quantity q_L^*, there is no low enough $\tilde{q}_H > 0$ which attracts a retailer, given $\tilde{w}_H > c_H$.[20]

[20] If H offered a sufficiently small $\tilde{q}_H$ in combination with $c_H < \tilde{w}_H < a$, both retailers (and thus the deviating supplier H) would profit by mutually accepting H's offer. However, the retailers suffer from a "prisoners' dilemma".

If Δ is small, supplier L cannot maintain its monopoly contract. In this case, if we had $\hat{w}_L < \hat{w}_H$, and the retailers strictly preferred L's offer, L could do better by slightly increasing w_L such that choosing L would still be a dominant strategy for the retailers. Similarly, if the retailers are indifferent between the two suppliers' offers (and accept L's offer, see Assumption 2), we show in Appendix A.9 that L's best reaction to any of H's offers Φ_H involves $w_L^* \geq w_H$. Together with Lemma 6, this implies $w_H^* = w_L^* = c_H$.

Lemma 8. *If* $0 \leq \Delta < 3(a-c)/5$*, in any equilibrium each supplier* $s \in \{H, L\}$ *offers* Φ_s^* *with* $q_s^* = (a - c_{-s})/3b$*. Together with Lemma 7, this implies that there is no equilibrium whenever* $0 < \Delta < 3(a-c)/5$*. If* $\Delta = 0$*, there exists a unique equilibrium.*

Lemma 8 states that, if $\Delta = 0$, both suppliers offer the Cournot duopoly quantity at a wholesale price equal to the suppliers' marginal cost. Accordingly, both retailers are provided with the quantity which they would have chosen themselves. If, say, supplier $-s$ would offer a different quantity, the contract of supplier s which includes the Cournot quantity would be strictly better. This would give s an incentive to increase its wholesale price w_s.

If $\Delta > 0$, Lemma 8 requires that each supplier offers the Cournot quantity with marginal costs of the *other* supplier. If this could be done by simultaneously offering a wholesale price which equals the other supplier's marginal cost, there would not be a way to profitably deviate. This, however, is not possible for the inefficient supplier H which would incur losses by doing so. That is, L is more competitive, and it follows from standard results of Cournot theory that L's quantity lies above H's quantity. In this case, L wants to decrease its wholesale price, which is in contrast to the result of Lemma 7. Accordingly, there is no equilibrium for $0 < \Delta < 3(a-c)/5$.

Before we summarize the results of Lemmas 5 through 8 in Proposition 2, we discuss the possibility of equilibria without exclusivity clauses.

What Happens if Exclusivity Clauses are Banned? As in the previous section, we compare the above equilibria with results which emerge under a ban on exclusivity clauses.

In a "no-exclusivity" equilibrium Φ_s^{NE} with $e_s = 0$ for $s = \{H, L\}$, first suppose that both suppliers offer positive quantities which are accepted by the retailers. If this is true, retailer r has no incentive to deviate by not purchasing from supplier s. That is,

$$\begin{aligned} & (a - 2bq_s - 2bq_{-s} - w_s)q_s \\ + \; & (a - 2bq_s - 2bq_{-s} - w_{-s})q_{-s} \\ \geq \; & (a - bq_s - 2bq_{-s} - w_{-s})q_{-s}. \end{aligned} \tag{9}$$

Furthermore, (9) has to hold as an equality, as otherwise supplier s could increase its wholesale price w_s without deterring any retailer. Upon simplification, this implies $w_s = a - b(2q_s + 3q_{-s})$, and in an equilibrium each supplier $s \in \{H, L\}$ solves

$$\begin{aligned} (q_s^{NE}, w_s^{NE}) = & \arg\max_{q_s, w_s} (w_s - c_s)2q_s \\ & \text{s.t. } w_s = a - b(2q_s + 3q_{-s}), \end{aligned} \tag{10}$$

which yields the reaction function of supplier s,

$$q_s^{NE}(q_{-s}^{NE}) = \frac{a - c_s}{4b} - \frac{3}{4} q_{-s}^{NE}. \tag{11}$$

Together with the constraint in (10), equation (11) implies

$$q_s^{NE} = (a + 3c_{-s} - 4c_s)/7b, \tag{12}$$

$$w_s^{NE} = (2a + 6c_{-s} - c_s)/7, \tag{13}$$

and

$$\pi_s^{NE} = (2a + 6c_{-s} - 8c_s)^2/49b.$$

If $\Delta > (a - c)/7$, we have $q_H^{NE} = 0$, and L acts as a monopolist in the upstream market. Therefore, L sells $q_L^{NE} = (a - c + \Delta)/4b$ at $w_L^{NE} = (a + c - \Delta)/2$. In this case, H cannot make an offer which the retailers accept *in addition* to L's offer. H can, however, attempt to make an offer which the retailers choose *instead* of L's offer. Since each retailer r obtains

$\pi_r^{NE} = 0$ at L, H could attract r and obtain a positive profit by offering $\tilde{\Phi}_H$ with $\tilde{w}_H = c_H + \varepsilon$, $\varepsilon > 0$, and $(a - bq_L^{NE} - b\tilde{q}_H - \tilde{w}_H)\tilde{q}_H > 0$. As it is possible to find such an offer whenever $0 < \Delta < 3(a-c)/5$, there is no equilibrium within this range.

If $\Delta \geq 3(a-c)/5$, the inefficient supplier H has no means to challenge L's monopoly behavior. Accordingly, the outcome under a ban on exclusivity clauses mirrors the outcome when exclusivity clauses are allowed (see Lemma 7). In fact, due to the absence of H's competitiveness, the market structure is the same as with only one supplier. Of course, under such circumstances it is irrelevant to distinguish between varying exclusivity regimes.

Will Exclusivity Clauses Be Used? First consider the case where, under a ban of exclusivity clauses, both suppliers sell positive quantities; that is, $\Delta \leq (a-c)/7$. In this case, once exclusivity clauses are allowed, $(\Phi_H^{NE}, \Phi_L^{NE})$ with $e_s^{NE} = 0$ for $s = \{H, L\}$ no longer constitutes an equilibrium. More precisely, supplier H could profitably deviate by offering an alternative contract $\tilde{\Phi}_H$ with $\tilde{q}_H = 2(a-c)/7b$, $\tilde{w}_H = (2a+5c)/7 - \varepsilon$, and $\tilde{e}_H = 1$. That is, in addition to imposing an exclusivity clause, H could offer the total quantity of both suppliers, given in (12), at a wholesale price which is slightly below the average wholesale price, given in (13). To see this, first note from Result 1, it is a dominant strategy for retailer r to choose H's offer whenever

$$\begin{aligned} &(a - 2b\tilde{q}_H - \tilde{w}_H)\tilde{q}_H > (a - b\tilde{q}_H - bq_L^{NE} - w_L^{NE})q_L^{NE} \\ \Leftrightarrow\ &\varepsilon[(a-c)/7] > -\Delta^2. \end{aligned}$$

which holds for all $\Delta \geq 0$ and $\varepsilon > 0$. Consequently, H's deviation profit would exceed H's equilibrium profit in the case of a ban on exclusivity clauses whenever

$$\begin{aligned} &(\tilde{w}_H - c_H)2\tilde{q}_H > \pi_H^{NE} = 4(a - c - 7\Delta)/49b \\ \Leftrightarrow\ &\varepsilon[28(a-c)^2] < (a-c)^2 - 49\Delta^2 + 7(a-c)\Delta. \end{aligned} \tag{14}$$

Since for $\Delta < (a-c)/7$ it holds that $49\Delta^2 < (a-c)^2$, the right-hand side of (14) is positive for all $\Delta \in [0, (a-c)/7]$. Hence, there exists $\varepsilon > 0$ such that both retailers would prefer H's alternative contract $\tilde{\Phi}_H$, and H would increase its profit.

Next, consider the case where only L sells a positive quantity in the absence of exclusivity clauses. As we have shown in the previous paragraph, in this case it is not possible for supplier H to persuade a retailer to choose H instead of L, neither with nor without exclusivity clauses. Furthermore, L obtains its unconstrained profit maximum. Therefore, if $\Delta \geq 3(a-c)/5$, equilibria require no restrictions on exclusivity clauses of either supplier.

Finally, regarding equilibria with exclusivity clauses, unilateral deviations from $e_s^* = 1$ to $\tilde{e}_s = 0$ are effectless, and the offers Φ_s^* of Lemma 8, together with $e_s^* = 1$ for $s = \{H, L\}$ constitute an equilibrium indeed. However, there are two additional equilibria where only one supplier imposes an exclusivity clause. If $\Delta = 0$, and the opponent supplier sets $e_{-s}^* = 0$, supplier s which sets $e_s^* = 1$ could remove bilateral exclusivity by individually switching to $\tilde{e}_s = 0$. Nevertheless, in this case, inequality (9), together with $q_{-s}^* = (a-c)/3b$, requires $\tilde{w}_s \leq c - 2b\tilde{q}_s$, which prevents s from obtaining a positive profit.

We summarize the results of this section in Proposition 2.

Proposition 2. *Consider the case where suppliers can engage in exclusive dealing. For $\Delta = 0$, each supplier $s \in \{H, L\}$ offers Φ_s^* with $q_s^* = (a-c)/3b$, $w_s^* = c$, and $e_r^* \in \{0, 1\}$. At least one supplier sets $e_r^* = 1$. Both retailers accept the offer of supplier L. The output price is $p^* = (a+2c)/3$. Both suppliers make zero profit. The profit of each retailer is $\pi_r^* = (a-c)^2/9b$. For $0 < \Delta < 3(a-c)/5$, there is no equilibrium. For $\Delta \geq 3(a-c)/5$, there is a continuum of equilibria where supplier L offers $\Phi_L^* = \Phi_L^{NE}$ with $q_L^* = (a-c+\Delta)/4b$, $w_L^* = (a+c-\Delta)/2$, and $e_L^* \in \{0, 1\}$. Supplier H's offer is such that both retailers accept Φ_L^*. Both retailers and supplier H make zero profit. The profit of supplier L is $\pi_L^* = (a-c+\Delta)^2/4b$.*

5 Discussion

In order to discuss welfare properties of both unconstrained outcomes and equilibria in the case of a ban on exclusivity clauses, it is convenient to compare the customer prices arising from final demand. Since the retailers' and suppliers' participation constraints ensure that no inefficiently high quantity is provided, equilibrium customer prices can be used to compare utilitarian welfare levels.

In Table 1, we provide an overview of the customer prices as they depend on the suppliers' difference in efficiency, on the policy towards exclusivity clauses, and on whether the retailers or the suppliers offer contracts.

$\Delta \in$	0	$\left(0, \frac{a-c}{7}\right]$	$\left(\frac{a-c}{7}, \frac{a-c}{3}\right)$	$\left[\frac{a-c}{3}, \frac{3(a-c)}{5}\right)$	$\left[\frac{3(a-c)}{5}, a-c\right)$
			Exclusive Provision		
Exclusivity allowed	$\frac{a+c}{2}$	—	—	$\frac{a+c-\Delta}{2}$	$\frac{a+c-\Delta}{2}$
Exclusivity banned	$\frac{a+2c}{3}$	$\frac{a+2(c-\Delta)}{3}$	$\frac{a+2(c-\Delta)}{3}$	$\frac{a+2(c-\Delta)}{3}$	$\frac{a+2(c-\Delta)}{3}$
			Exclusive Dealing		
Exclusivity allowed	$\frac{a+2c}{3}$	—	—	—	$\frac{a+c-\Delta}{2}$
Exclusivity banned	$\frac{3a+4c}{7}$	$\frac{3a+4c}{7}$	—	—	$\frac{a+c-\Delta}{2}$

Table 1: Values of the customer price for various regimes and values of Δ.

If the retailers make offers, customer prices are higher once exclusivity clauses are allowed. This holds because, without exclusivity clauses, the retailers do not have to compete for suppliers, as the latter accept any offer which covers their production cost. Accordingly, the retailers' appetite for higher quantities is only restrained by the negatively-sloped downstream demand curve. This leads them to engage in Cournot competition, which implies $p^* = (a+2(c-\Delta))/3$. In contrast, in the presence of exclusive provision, suppliers only accept the most favorable contract, which induces the retailers to strongly compete. As a result, the retailers are obliged to promise up to the maximum they can reap in the downstream market. Consequently, they have to offer the monopoly surplus, which they obtain from the customers thereupon. Even if the retailers only compete for the efficient supplier L, the resulting customer price, $p^* = (a + c - \Delta)/2$, still exceeds the customer price without exclusivity clauses, $p^{NE} = (a + 2(c - \Delta))/3$.

This result is reversed once we examine the opposite setting where the suppliers make offers. In this case, customer prices are lower with exclusivity clauses than without. Similarly as described above, exclusivity clauses force the suppliers to intensely compete for the retailers. Thus they have to offer the best possible contract from an individual retailer's perspective; that is, they sell Cournot quantities at wholesale prices which equal their marginal cost of production. A ban on exclusivity clauses, in principle, alleviates competition, as in this case suppliers do not have to outperform their competitors in order to be taken into consideration. However, when faced with large quantities, retailers may profit from denying a contract, as this increases the customer price they obtain in the downstream market. Therefore, from equation (9), each supplier s is constrained by

$$w_s = a - b(2q_s + 3q_{-s}). \tag{15}$$

By solely considering (15) (and supposing that $w_s = c_s$), we would find that a ban on exclusive dealing increases the altogether provided quantity. However, if wholesale prices were set at marginal cost, the suppliers would obtain zero profit. This can be avoided by increasing w_s, conditional on ensuring that (15) still holds. Thus q_s has to be reduced, which leads to a higher customer price than in the case with exclusivity clauses.[21]

When allowed, irrespective of which side of the market makes offers, exclusivity clauses are used (as long as there is no de-facto monopoly of a substantially more efficient supplier L). Taking this into account, Table 1 shows that offers of the retailers lead to higher customer prices than offers

[21] If $\Delta \geq 3(a-c)/5$, there is no difference between contracts with and without exclusivity clauses. As discussed in Section 4, such a setting corresponds to a quasi-monopoly of the more efficient supplier, where exclusivity regimes do not matter anymore.

of the suppliers. In both instances the firms necessarily maximize the profit of the other side of the market. If the suppliers propose contracts, however, maximizing an individual retailer's surplus implies offering a higher quantity, since part of the negative customer-price effect is passed on to the competing retailer. Such externalities are absent if the retailers make offers.[22] Therefore, retailers are better capable of maximizing the joint surplus of the vertical supply chain, which leads to higher customer prices.

Which Side of the Market Makes Offers? The question which consequently arises is whether we rather expect exclusive provision (Section 3) or exclusive dealing (Section 4) to prevail. Instead of building up a theoretical superstructure, we refer to the Coase's (1960) theorem, which essentially postulates that voluntary contracts between firms necessarily maximize these firms' joint benefit. Accordingly, contracts will be specified in such a way that there is no alternative contract with a higher joint surplus. As profit increases can be split between the contracting parties, profit-maximizing contracts will be agreed upon. Therefore, by reasoning along the lines of the previous sections, exclusive dealing cannot be sustained once we allow for counteroffers on behalf of the retailers. The latter are more capable to extract the customers' willingness to pay. Therefore, in principle, equilibria where the suppliers make offers (as in Section 4) can be eliminated. Retailers find a counteroffers which lead to a Pareto-superior allocations. Whether the above discussed instruments (quantites, wholesale prices, exclusivity clauses) are sufficient to reach the equilibrium of Section 3, or whether side-payments are required, clearly depends on the structure of the "counteroffer game". For the present paper, we leave this issue aside.

[22] Externalities are also absent in case of exclusive dealing with a monopolistic retailer, as in Bernheim and Whinston (1998). They find that "the form of representation (i.e., exclusivity or common representation) is chosen to maximize the joint surplus of the [vertical supply chain]". This result does not apply here, as the suppliers are forced to use exclusivity clauses, although the thus generated externalities result in a jointly less profitable allocation.

6 Conclusion

In contrast to previous work, in our setup exclusivity clauses are neither used to foreclose, nor do they align incentives. Instead they are necessary features of competitive contracts. Nevertheless, their welfare effect may be detrimental, because competitive forces are not directed towards the well-being of customers. Rather, to stay in business, contract-issuing firms have to maximize the profit of their counterparts in the upstream market.

Of course, our results hinge on the specification of the framework. In particular, firms are able to commit on an array of variables such as prices, quantities, and exclusivity clauses. Hence possible extensions of the model would allow firms to offer "menu contracts" or include bargaining on the terms of trade.

Regarding policy implications, our analysis suggests that prohibiting exclusivity clauses potentially improves welfare. An overall ban, however, seems to be premature. Despite our conjecture that "exclusive provision" arises endogenously, in practice we often observe "exclusive dealing". For this case, we have shown that a prohibition of exclusivity clauses might reduce efficiency. Moreover, firms could be induced to substitute exclusivity clauses by other vertical restraints such as retail price maintenance, quantity discounts, exclusive territories, tying and the like.

Against this ambiguous background, it seems consistent that both the United States[23] and the European Union[24] treat exclusive contracts under a rule-of-reason approach, in which economic efficiencies are balanced against anticompetitive effects. Nevertheless, as exemplified, policy makers should not be mislead by the competition-promoting effect of exclusivity clauses: In fact, it is precisely this effect which may force contract-issuing firms to exploit their final customers.

[23] See Continental T.V., Inc. v. GTE Sylvania, Inc., 433 U.S. 36 (1977).

[24] See European Commission (2010).

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Appendix

A.1 Proof of Lemma 1

Consider the case where both suppliers' participation constraints are satisfied. Then, with $w_r^* = a - b2q_r^*$, it follows from equation (5) that both retailers obtain zero profit.

To the contrary, suppose there is an equilibrium $\hat{\Phi}_r$ with $\hat{w}_r > a - b2\hat{q}_r$. In this case, both retailers make losses. By offering $\tilde{\Phi}_r$ with $\tilde{q}_r(\tilde{w}_r - c_s) < \hat{q}_r(\hat{w}_r - c_s)$ for $s \in \{H, L\}$, a deviating retailer r would not be chosen by any supplier, which improves r's profit to 0.

Suppose next that $\hat{w}_r < a - b2\hat{q}_r$. In this case,

$$\hat{\pi}_r = (a - 2b\hat{q}_r - \hat{w}_r)\hat{q}_r > 0. \tag{A.1}$$

Due to the continuity of (A.1), for all $\varepsilon > 0$ there exist an alternative contract $\tilde{\Phi}_r$ with $\tilde{q}_r > \hat{q}_r$ and $\tilde{w}_r > \hat{w}_r$ such that

$$(a - 2b\tilde{q}_r - \tilde{w}_r)\tilde{q}_r > \hat{\pi}_r - \varepsilon.$$

But if $\tilde{q}_r > \hat{q}_r$ and $\tilde{w}_r > \hat{w}_r$, we have $\tilde{q}_r(\tilde{w}_r - c_s) > \hat{q}_r(\hat{w}_r - c_s)$ and both suppliers approach the deviating firm r. In this case, r's profit is

$$\tilde{\pi}_r = (a - 2b\tilde{q}_r - \tilde{w}_r)2\tilde{q}_r > 2(\hat{\pi}_r - \varepsilon). \tag{A.2}$$

By comparing (A.1) with (A.2), we observe that $\tilde{\pi}_r > \hat{\pi}_r$ for all $\varepsilon < \hat{\pi}_r/2$.

The proof where only the efficient supplier L's participation constraint is satisfied is analogous.

A.2 Proof of Lemma 2

To the contrary, suppose that in a symmetric equilibrium $\hat{\Phi}_r$ the retailers obtain zero profits, but neither supplier's profits are maximized subject to the retailers' zero-profit condition. In this case, if both suppliers' participation constraints are satisfied, we have

$$\mathrm{MRS}_s(\hat{q}_r, \hat{w}_r) := -\frac{\hat{w}_r - c_s}{\hat{q}} \neq -2b,$$

for $s \in \{H, L\}$, and, if only the efficient supplier L's participation constraint is satisfied, we have

$$\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) = -\frac{\hat{w}_r - c_H}{\hat{q}} \neq -b.$$

If no participation constraint is satisfied, trivially, a deviating retailer could offer a sufficiently attractive contract, which would increase its profit from zero to a positive value.

Next consider putative symmetric equilibria $\hat{\Phi}_r$ where both suppliers' participation constraints are satisfied. Since, for all $(\hat{q}_r, \hat{w}_r)$, $\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) < \mathrm{MRS}_H(\hat{q}_r, \hat{w}_r)$, we can distinguish between the following three (exhaustive) cases for which $\mathrm{MRS}_s(\hat{q}_r, \hat{w}_r) \neq -2b$ for $s \in \{H, L\}$. For each case, by deriving profitable deviation strategies, we show that it cannot constitute an equilibrium.

Case 1: $\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) \leq \mathrm{MRS}_H(\hat{q}_r, \hat{w}_r) < -2b$.
First note that in such a case, both suppliers' participation constraints are *strictly* satis-

fied. This is because, from $\hat{w}_r \leq c_H$ follows $\mathrm{MRS}_H(\hat{q}_r, \hat{w}_r) \geq 0$, which is a contradiction to $\mathrm{MRS}_H(\hat{q}_r, \hat{w}_r) < -2b$.

Because both suppliers' participation constraints are strictly satisfied, a deviating retailer r could attract both suppliers by marginally increasing q_r and adjusting (lowering) $w_r(q_r)$ in a manner that

$$\frac{\mathrm{d}w_r}{\mathrm{d}q_r} > \mathrm{MRS}_H(\hat{q}_r, \hat{w}_r). \tag{A.3}$$

In this case, r's profit function would be

$$\pi_r = (a - 2bq_r - w_r(q_r))2q_r, \tag{A.4}$$

which equals $\hat{\pi}_r = 0$ at $(q_r, w_r) = (\hat{q}_r, \hat{w}_r)$. The first-order effect on π_r from increasing q_r would be

$$\left[\frac{\mathrm{d}\pi_r}{\mathrm{d}q_r}\right]_{(q_r,w_r)=(\hat{q}_r,\hat{w}_r)} = \left(-2b - \frac{\mathrm{d}w_r}{\mathrm{d}q_r}\right) 2\hat{q}_r. \tag{A.5}$$

Since, by assumption, there exists $\varepsilon > 0$ such that $\mathrm{MRS}_H(\hat{q}_r, \hat{w}_r) < -2b - \varepsilon$, r could choose $\mathrm{d}w_r/\mathrm{d}q_r = -2b - \varepsilon$, which satisfies (A.3) and renders (A.5) positive.

Case 2: $-2b < \mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) \leq \mathrm{MRS}_H(\hat{q}_r, \hat{w}_r)$.
Then, a deviating retailer r could attract both suppliers by marginally decreasing q_r and adjusting (increasing) $w_r(q_r)$ in a manner that

$$\frac{\mathrm{d}w_r}{\mathrm{d}(-q_r)} > -\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) \;\; \Leftrightarrow \;\; \frac{\mathrm{d}w_r}{\mathrm{d}q_r} < \mathrm{MRS}_L(\hat{q}_r, \hat{w}_r). \tag{A.6}$$

In this case, r's profit function would be (A.4), and the first-order effect on π_r from decreasing q_r would be

$$\left[\frac{\mathrm{d}\pi_r}{\mathrm{d}(-q_r)}\right]_{(q_r,w_r)=(\hat{q}_r,\hat{w}_r)} = \left(2b + \frac{\mathrm{d}w_r}{\mathrm{d}q_r}\right) 2\hat{q}_r. \tag{A.7}$$

Since, by assumption, there exists $\varepsilon > 0$ such that $\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) > -2b + \varepsilon$, r could choose $\mathrm{d}w_r/\mathrm{d}q_r = -2b + \varepsilon$, which satisfies (A.6) and renders (A.7) positive.

Case 3: $\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) < -2b < \mathrm{MRS}_H(\hat{q}_r, \hat{w}_r)$.
In this case, we necessarily have $\Delta > 0$, and supplier L's participation constraint is strictly satisfied. Therefore, a deviating retailer r could attract supplier L without attracting supplier H by marginally increasing q_r and adjusting (lowering) $w_r(q_r)$ in a manner that

$$\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) < \frac{\mathrm{d}w_r}{\mathrm{d}q_r} < \mathrm{MRS}_H(\hat{q}_r, \hat{w}_r). \tag{A.8}$$

In this case, r's profit function would be

$$\pi_r = (a - b\hat{q}_r - bq_r - w_r(q_r))q_r, \tag{A.9}$$

and the first-order effect on π_r from increasing q_r would be

$$\left[\frac{\mathrm{d}\pi_r}{\mathrm{d}q_r}\right]_{(q_r,w_r)=(\hat{q}_r,\hat{w}_r)} = \left(-b - \frac{\mathrm{d}w_r}{\mathrm{d}q_r}\right) \hat{q}_r. \tag{A.10}$$

By assumption, $\mathrm{d}w_r/\mathrm{d}q_r = -2b$ satisfies (A.8) and renders (A.10) positive.

Finally, we consider putative equilibria where only the efficient supplier L's participation constraint is satisfied, that is, $\hat{w}_r < c_H$. In this case, whenever $\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) \neq -b$, there exists a combination $(\tilde{q}_r, \tilde{w}_r)$ below the zero-profit line $\hat{w}_r = a - b\hat{q}_r$, which is preferred by L as compared to $(\hat{q}_r, \hat{w}_r)$. Since $\hat{w}_r < c_H$, the less-efficient supplier H would not be attracted by marginal changes in (q_r, w_r), which leaves the zero-profit line unaffected. Thus, r can profitably deviate in a similar manner as described above.

A.3 *Proof of Corollary 1*

If $\Delta = 0$, Lemma 2 requires (w_r^*, q_r^*) to maximize $q_r(w_r - c)$ conditional on (6). Accordingly, we have

$$(q_r^*, w_r^*) = \arg\max_{q_r, w_r}(w_r - c)q_r \text{ s.t. } w_r = a - b2q_r = ((a-c)/4b, (a+c)/2).$$

A.4 *Proof of Lemma 3*

Suppose there exists an equilibrium $\hat{\Phi}_r$ with $\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) < -2b = \mathrm{MRS}_H(\hat{q}_r, \hat{w}_r)$. A deviating retailer r could attract supplier L without attracting supplier H by marginally increasing q_r and adjusting (lowering) $w_r(q_r)$ in a manner that

$$\mathrm{MRS}_H(\hat{q}_r, \hat{w}_r) > \frac{\mathrm{d}w_r}{\mathrm{d}q_r} > \mathrm{MRS}_L(\hat{q}_r, \hat{w}_r). \tag{A.11}$$

In this case, r's profit function would be given by (A.9), and the first-order effect on π_r from increasing q_r would be given by (A.10). Since, by assumption, there exists $\varepsilon > 0$ such that $\mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) + \varepsilon < -2b$, r could choose $\mathrm{d}w_r/\mathrm{d}q_r = -2b - \varepsilon$, which satisfies (A.11) and renders (A.10) positive.

A.5 *Proof of Lemma 4*

First suppose that both suppliers' participation constraints are satisfied in a symmetric equilibrium $\hat{\Phi}$. From Lemmas 1 through 3 we know that in such an equilibrium

$$(q_r^*, w_r^*) = \arg\max_{q_r, w_r}(w_r - c_L)q_r \text{ s.t. } w_r = a - b2q_r = ((a-c_L)/4b, (a+c_L)/2),$$

$\hat{\pi}_r = 0$, $\hat{\pi}_L = (a - c_L)^2/8b$, and $\hat{\pi}_H = (a - c_L)/4b \times (a + c_L - 2c_H)/2$. By increasing q_r and adjusting (lowering) w_r such that the utility of supplier L is marginally increased, retailer r's offer would only be attractive for L, and H would stay with the competing retailer $-r$, which offers $(\hat{q}_r, \hat{w}_r)$. In this case, r's profit function would be

$$\pi_r = (a - b\hat{q}_r - bq_r - w_r(q_r))q_r,$$

where $w_r(q_r)$ is such that a marginal deviation of $(q_r, w_r(q_r))$ from $(\hat{q}_r, \hat{w}_r)$ only attracts supplier L. The first-order effect on π_r from increasing q_r then would be

$$\left[\frac{\mathrm{d}\pi_r}{\mathrm{d}q_r}\right]_{(q_r,w_r)=(\hat{q}_r,\hat{w}_r)} = \left(-b - \frac{\mathrm{d}w_r}{\mathrm{d}q_r}\right)\hat{q}_r. \tag{A.12}$$

Since $\mathrm{MRS}_H(\hat{q}_r, \hat{w}_r) > \mathrm{MRS}_L(\hat{q}_r, \hat{w}_r) = -2b$, by choosing $\mathrm{d}w_r/\mathrm{d}q_r = -2b + \varepsilon$, with ε sufficiently small, retailer r would attract supplier L, whereas supplier H would stay with retailer $-r$, which offers $(\hat{q}_r, \hat{w}_r)$. As a result, (A.12) would be positive, which eliminates the putative equilibrium.

Next, consider the case where H's participation constraint is violated in an equilibrium Φ_r^*. From Lemma 2, we know that in this case L's profit must be maximized conditional on the retailers' zero-profit condition (7). Therefore, from a similar computation as in Corollary 1, Φ_r^* involves $q_r^* = (a - c + \Delta)/2b$, $w_r^* = (a + c - \Delta)/2$, $\pi_r^* = 0$, $\pi_L^* = (a - c + \Delta)^2/4b$, and $\pi_H^* = 0$. As L's profit is maximized conditional on (7), every potentially profitable deviation $\tilde{\Phi}_r$ from Φ_r^* involves attracting H.

It follows from r's profit function (5) that any deviation $\tilde{\Phi}_r$ which attracts *both* suppliers is only profitable if $\tilde{w}_r < a - 2b\tilde{q}_r$. Since in the proposed equilibrium $\pi_L^* = q_r^*(w_r^* - c_L)$ is maximized conditional on $w_r^* \leq a - bq_r^*$, no profitable $\tilde{\Phi}_r$ which attracts both suppliers exists.

On the other hand, if a deviation consists of attracting H without attracting L, the profit of the deviating retailer equals

$$\tilde{\pi}_r = (a - bq_r^* - b\tilde{q}_r - \tilde{w}_r)\tilde{q}_r.$$

As H's participation constraint ($w_r^* \geq c_H$) is violated if and only if $\Delta > (a - c)/3$, it follows that $q_r^* > 2(a - c)/3b$. Attracting supplier H further requires $\tilde{w}_r \geq c_H$, thus we have

$$\tilde{\pi}_r < \left(a - b\left[\frac{2(a-c)}{3b}\right] - b\tilde{q}_r - c_H\right)\tilde{q}_r.$$

By writing $c_H = c + \Delta$, $\Delta > (a - c)/3$ implies

$$\tilde{\pi}_r < -b\tilde{q}_r^2 < 0.$$

A.6 Proof of Result 1

We prove Result 1 for the case of strict dominance. For weak dominance, the proof is identical, except that weak inequalities are replaced by strict ones.

In addition to condition (8), strict dominance requires

$$(a - bq_s - bq_{-s} - w_s)q_s > \ (a - 2bq_{-s} - w_{-s})q_{-s}. \tag{A.13}$$

Since (8) can be rewritten as $(a - bq_s - bq_{-s} - w_s)q_s > (a - 2bq_s - bq_{-s} - w_{-s})q_{-s} + bq_s^2$, (8) implies (A.13) whenever

$$\begin{aligned} &(a - 2bq_s - bq_{-s} - w_{-s})q_{-s} + bq_s^2 > (a - 2bq_{-s} - w_{-s})q_{-s} \\ \Leftrightarrow\ &(q_s - q_{-s})^2 > 0. \end{aligned}$$

This is true whenever $q_s \neq q_{-s}$. If $q_s = q_{-s}$, inequality (8) requires $w_s < w_{-s}$, which also implies inequality (A.13).

A.7 Proof of Lemma 5

Any equilibrium $(\hat{\Phi}_H, \hat{\Phi}_L)$ where H is chosen by the retailers requires $\hat{w}_H \geq c_H$, because H could avert negative profits by offering a sufficiently unattractive contract $\tilde{\Phi}_H$.

If $\hat{w}_H > c_H$ and the retailers choose H, L could attract both retailers by offering $\tilde{\Phi}_L$ with $\tilde{q}_L = \hat{q}_H$ and $\tilde{w}_L = \hat{w}_H - \varepsilon$ with $\varepsilon > 0$ sufficiently small. In this case, choosing L would be a strictly dominant strategy for both retailers, and L's profit would increase from 0 to $(\tilde{w}_L - c_L)\tilde{q}_L > (c_H - c_L)\hat{q}_H \geq 0$.

To rule out the case that the retailers choose H when $\hat{w}_H = c_H$, recall that Assumption 2 requires

$$\hat{\pi}_r = (a - 2b\hat{q}_H - \hat{w}_H)\hat{q}_H > \hat{\pi}_r(L), \tag{A.14}$$

where $\hat{\pi}_r(L)$ denotes retailer r's profit which could be obtained by accepting supplier L's offer instead. But then, H could also offer $\tilde{\Phi}_H$ with $\tilde{q}_H = \hat{q}_H$ and $\tilde{w}_H = \hat{w}_H + \varepsilon$. For sufficiently small values of $\varepsilon > 0$, inequality (A.14) would remain valid, and both retailers would still opt for supplier H. Furthermore, H's profit would increase, which eliminates the remaining candidate equilibrium where H is chosen by the retailers.

A.8 Proof of Lemma 6

Assumption 3 rules out equilibria with $\hat{w}_H < c_H$, hence $w_H^* \geq c_H$.

Next suppose that $\hat{w}_L > c_H$. From Lemma 5, we know that both retailers choose supplier L, and thus the profit of supplier H is $\hat{\pi}_H = 0$. By offering $\tilde{\Phi}_H$ with $\tilde{q}_H = \hat{q}_L$ and $\tilde{w}_H = \hat{w}_L - \varepsilon$ with $\varepsilon > 0$ sufficiently small, choosing H would be a strictly dominant strategy for both retailers. In this case, H's profit would be $\tilde{\pi}_H = (\tilde{w}_H - c_H)2\tilde{q}_H = (\hat{w}_L - \varepsilon - c_H)2\hat{q}_L > 0$.

A.9 Proof of Lemma 7

As it follows from Lemma 5 that supplier H is not chosen in any equilibrium, we have

$$(a - 2b\hat{q}_L - \hat{w}_L)\hat{q}_L \geq \max\left\{(a - b\hat{q}_L - b\hat{q}_H - \hat{w}_H)\hat{q}_H, 0\right\}. \tag{A.15}$$

From Result 1, (A.15) implies that it is a strictly dominant strategy for the retailers to choose supplier L whenever (A.15) holds strictly. Then, however, L could offer $\tilde{\Phi}_L$ with $\tilde{q}_L = \hat{q}_L$ and $\tilde{w}_L = \hat{w}_L + \varepsilon$ with $\varepsilon > 0$ sufficiently small. In this case, inequality (A.15) would remain valid; that is, choosing L would still be a dominant strategy for both retailers. Furthermore, L's profit would be higher by offering $\tilde{\Phi}_L$ than by offering $\hat{\Phi}_L$, which eliminates all (candidate) equilibria with $(a - 2b\hat{q}_L - \hat{w}_L)q_L > \max\{(a - b\hat{q}_L - b\hat{q}_H - \hat{w}_H)q_H, 0\}$.

Otherwise, if (A.15) holds with equality, we distinguish between the following cases.

Case 1: $(a - b\hat{q}_L - b\hat{q}_H - \hat{w}_H)\hat{q}_H \leq 0$.
In this case, L solves

$$(\hat{q}_L, \hat{w}_L) = \arg\max_{q_L, w_L} (w_L - c_L)2q_L \text{ s.t. } w_L = a - 2bq_L,$$

which yields $\hat{q}_L = (a - c_L)/4b$ and $\hat{w}_L = (a + c_L)/2$. In this case, each retailer r obtains $\hat{\pi}_r = 0$ at L.

This, however, cannot be an equilibrium if $\Delta < 3(a - c)/5$, because then H could attract r and obtain a positive profit by offering $\tilde{\Phi}_H$ with $\tilde{w}_H = c_H + \varepsilon$ and $(a - b\hat{q}_L - b\tilde{q}_H - \tilde{w}_H)\tilde{q}_H > 0$. Therefore, the suggested equilibrium only exists for $\Delta \geq 3(a - c)/5$.

Case 2: $(a - b\hat{q}_L - b\hat{q}_H - \hat{w}_H)\hat{q}_H > 0$.

To show that any equilibrium with $(a - b\hat{q}_L - b\hat{q}_H - \hat{w}_H)\hat{q}_H > 0$ requires $w_H^* = w_L^* = c_H$, it follows from Lemma 6 that it is sufficient to show that $\hat{w}_H > \hat{w}_L$ cannot be part of an equilibrium in this case.

From L's objective function and from (A.15), in any such equilibrium, L solves

$$\begin{aligned}(\hat{q}_L, \hat{w}_L) = &\arg\max_{q_L, w_L} (w_L - c_L)2q_L \\ &\text{s.t. } w_L = a - 2bq_L - \frac{q_H}{q_L}(a - bq_L - bq_H - w_H),\end{aligned} \tag{A.16}$$

which yields

$$\hat{q}_L(\hat{q}_H) = \frac{a - c_L}{4b} + \frac{\hat{q}_H}{4}. \tag{A.17}$$

From the constraint in (A.16), it follows that

$$\hat{w}_L \geq a - 2b\hat{q}_L - \underbrace{\max_{\hat{q}_L, \hat{q}_H} \left\{ \frac{\hat{q}_H}{\hat{q}_L}(a - b\hat{q}_L - b\hat{q}_H - \hat{w}_H) \right\}}_{=:\gamma_1}. \tag{A.18}$$

Furthermore, from the equality version of (A.15), and from the fact that in any equilibrium the retailers obtain non-negative profits, we have

$$\gamma_2 := a - b\hat{q}_L - b\hat{q}_H - \hat{w}_H \geq 0.$$

Therefore,

$$\frac{\partial \gamma_1}{\partial \hat{q}_L} = -\frac{\hat{q}_H}{\hat{q}_L^2}\gamma_2 + \frac{\hat{q}_H}{\hat{q}_L}(-b) < 0. \tag{A.19}$$

Now suppose that $\hat{q}_H \leq (a - c_L)/3b$. In this case, (A.17) implies

$$\hat{q}_H \leq \hat{q}_L \leq (a - c_L)/3b. \tag{A.20}$$

Therefore, from (A.19), subject to (A.20), γ_1 is maximized at $\hat{q}_L = \hat{q}_H$. Together with (A.18), this yields

$$\hat{w}_L \geq a - 2b\hat{q}_L - (a - 2b\hat{q}_L - \hat{w}_H) = \hat{w}_H, \tag{A.21}$$

which is the required contradiction to $\hat{w}_H > \hat{w}_L$ for the case that $\hat{q}_H \leq (a - c_L)/3b$.

Next, suppose that $\hat{q}_H \geq (a - c_L)/3b$. In this case, (A.17) implies

$$\hat{q}_H \geq \hat{q}_L \geq (a - c_L)/3b. \tag{A.22}$$

Therefore, from (A.19), subject to (A.22), γ_1 is maximized at $\hat{q}_L = (a - c_L)/3b$. From (A.17), this further requires $\hat{q}_H = (a - c_L)/3b$, and thus $\hat{q}_H = \hat{q}_L$. Therefore again, (A.18) implies (A.21), which constitutes the required contradiction to $\hat{w}_H > \hat{w}_L$ for the second case that $\hat{q}_H \geq (a - c_L)/3b$.

A.10 Proof of Lemma 8.

First suppose that supplier L instead offers $\hat{q}_L = (a - c_H)/3b + \delta$ with $\delta \neq 0$. In this case, H could offer $\tilde{\Phi}_H$ with $\tilde{q}_H = (a - c_H)/3b$ and $\tilde{w}_H = c_H + \varepsilon$. From Result 1, choosing H

is a dominant strategy for both retailers if and only if

$$\begin{aligned} &\tilde{\pi}_r := (a - 2b\tilde{q}_H - \tilde{w}_H)\tilde{q}_H > \hat{\pi}_r := (a - b\tilde{q}_H - b\hat{q}_L - c_H)\hat{q}_L \\ \Leftrightarrow\ &(b\delta)^2 > \varepsilon(a-c)/3. \end{aligned}$$

Hence, by setting $\varepsilon > 0$ sufficiently small, H would attract both retailers, and H would obtain a positive profit. This eliminates all equilibria with $\hat{q}_L \neq (a - c_H)/3b$.

Next suppose that supplier H offers $\hat{q}_H = (a - c_L)/3b + \delta$ with $\delta \neq 0$. In this case, we know from the strict inequality versions of (A.20), (A.21), and (A.22) (see the proof of Lemma 7) that $\hat{w}_L > \hat{w}_H$. This, however, contradicts Lemma 7, and eliminates all equilibria with $\hat{q}_H \neq (a - c_L)/3b$.

Using $q_s^* = (a - c_{-s})/3b$, equation (A.16) in Appendix A.9 implies $w_L^* \leq w_H^*$, where the inequality is strict if and only if $\Delta > 0$. But then it follows from Lemma 7 that there is no equilibrium for $\Delta > 0$.

If $c_H = c_H = c$, to show that Φ_s^* with $q_s^* = (a - c)/3b$ and $w_s^* = c$ constitutes an equilibrium, first consider potential deviations of supplier L. From the equality versions of (A.20), (A.21), and (A.22), we know that L's best answer to Φ_H^* indeed is Φ_L^* with $q_L^* = q_H^*$ and $w_L^* = w_H^*$. Regarding supplier H, first note that offering a contract with $\tilde{w}_H < c$ can never lead to a positive profit for H. Second, if H cannot attract any retailers by offering a contract with $\tilde{w}_H = c$, this is also not possible with any contract with $\tilde{w}_H > c$. If H offers $\tilde{\Phi}_H$ with $\tilde{w}_H = c$ and $\tilde{q}_H = (a - c)/3b + \delta$ with $\delta \neq 0$, both retailers accept the offer of L, since it follows from Result 1 that

$$\hat{\pi}_r := (a - 2b\hat{q}_L - \hat{w}_L)\hat{q}_L > \tilde{\pi}_r := (a - b\hat{q}_L - b\tilde{q}_H - \tilde{w}_H)\tilde{q}_H \Leftrightarrow \ \delta^2 > 0$$

implies that accepting L's offer is a dominant strategy for both retailers.